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Consequences of Elevation Characterization on Simulations of Drainage Flows in Mountain Valleys

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This work is part of a research effort into the relationship between geographic data as it is represented and manipulated in computer databases and mesoscale atmospheric models. An important class of geographic information, in the context of mesoscale atmospheric models, is elevation data. A situation where the terrain surface strongly affects atmospheric behavior, and therefore a useful test case for examining the effects of elevation data on mesoscale models, is the development of nocturnal drainage winds. Because such winds are driven by inhomogeneities in the temperature field caused by the cooling of the sloping land surface relative to the adjacent air, alterations in the representation of that surface are expected to have a measurable effect on a simulation of the associated flow.

Numerous simulations have been performed where an idealized valley system was represented with varying degrees of fidelity by the bottom boundary of the model. These differing representations corresponded to different resolutions of the elevation data and to different algorithms for resampling higher resolution to lower resolution elevation data. In addition, simulations were performed in which both coherent and random small-scale forcing was added to the idealized surface. These last simulations showed interesting relationships between the variations at the elevation surface and the presence of focused counterflows at the top of the drainage jet. We are refining these calculations and performing related sets of simulations using real valleys defined on the basis of digital elevation data to determine the if the various effects that were found in the idealized experiments can be demonstrated to occur field experiments. The ASCOT site in Brush Creek, Colorado will provide an example of a valley where many of the aspects of this work can be applied to real data. The Brush Creek simulations provide a basis to generalize conclusions drawn from the idealized valley studies to more realistic situations where observed meteorological and tracer data gives some additional basis for model evaluation.

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